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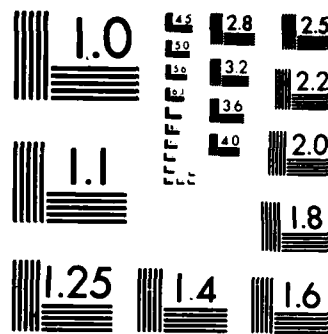
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HISTORY OF SPACEFLIGHT

by

Yu Lin



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HISTORY OF SPACEFLIGHT

(IV) Development of Application Satellite, Part I

Yu Lin

Ever since the opening of a new chapter of spaceflight activity on October 4, 1957, the Soviet Union and the United States had launched a total of nine scientific satellites in a little over one year's time and had obtained preliminary understanding of some conditions outside the earth's atmosphere to set the ground for further spaceflight activities. At that time, out of needs for military and civilian practical applications, in addition to continuing the development of scientific satellites and thoroughly studying the outer space the manufacturing of application satellites that have practical values had become a pressing matter of the moment. Thus, during a period of time afterward application satellites of various names sprang up in response like bamboo shoots after a spring rain.

Communications Satellites Jumped on the First Opportunity

As early as 1945, British engineer Clark had proposed to use three stationary satellites evenly distributed in the earth's space orbit to carry out the idea of global communications relay. However, this idea was postponed due to immature rocket technology at that time.

Starting from 1946, the United States began utilizing the moon to conduct satellite communications experiments, that is, to transmit radio waves toward the moon and use the reflection of radio waves by the moon to achieve communications. The experiments had shown that it was possible to use the moon for communications, but due to the existence of a series of serious shortcomings the project was sentenced to "death penalty". After the successful launch of the world first man-made satellite the experiments of satellite communications had turned to man-made earth satellites.

On December 18, 1958 the United States launched a "Score" satellite at Cape Canaveral (the present Kennedy Space Center) which started the study of utilizing man-made satellites for communications.

The "Score" satellite was a cylindrical body with coned tip and there were two sets of transceiver equipment, power supply transformer, radio transponder and control components installed on board the satellite that were connected with magnetic tape recorder and radar transponder. This satellite carried prerecorded magnetic tapes and conducted an experiment of broadcasting a speech recording by the President of the United States of America from space to the ground. The results of the experiment indicated that it was feasible to transmit audio messages and secret codes from satellite to the ground.

From 1958 to 1965 was the experimental stage of the development of the communications satellite. During this period the United States had successively launched many active and passive (no transceiver on board) experimental communications satellites into orbits of various altitudes. Among those that are worth mentioning are:

On July 10, 1961, the "Electric Star"-1 was launched by a "Zeus-Delta" three-stage payload rocket from Cape Canaveral and successfully conducted the first transatlantic experiment of television relay broadcast, photofacsimile and telephone communications between America and France and Great Britain, and its communications capacity was 600 channels of voice frequency telephone or one channel of television.

On July 26, 1963, the "Syncom" -2 was launched by "Delta" payload rocket from Cape Canaveral into a geosynchronous orbit and became the world first geosynchronous communication satellite which had been used in the communications business above the Atlantic Ocean. Although the average orbital altitude of said satellite was about 35,800 kilometers and its circling period was synchronous with the earth's rotational period, it did not become a stationary communications satellite because its orbital inclination angle reached 33.43 degrees.

On August 19, 1964, the "Delta" payload rocket (Figure 4-1) was again used and successfully launched the "Syncom" -3 (Figure 4-2) from Cape Canaveral which became the world first stationary satellite. The satellite was used to broadcast live television coverages of ^{the} Tokyo Olympic Games in Japan to North America and Europe.



Fig. 4-1

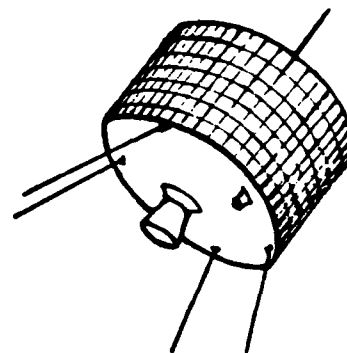


Fig. 4-2

Through experimental verifications of over six years, passive communications satellites have been eliminated from the list due to a variety of formidable shortcomings; stationary satellites, however, have earned the leading position in the family of communications satellites, for they command advantages such as long range, vast area, large capacity, high quality, good flexibility, low cost, etc. in communications.

On August 20, 1964, the "Financial Group of International Communications Satellites" (the name was later changed to Organization of International Communications Satellites and over one hundred countries have joined) was established, which was controlled by the American Communications Satellites Company. By April 6, 1965, said financial group launched the first commercial communications satellite---"Morning Bird" (later changed to be known as "Interncom Satellite"-1). In June of the same year, said satellite was formally used for international commercial communications between North America and Europe, and thus unveiled the application stage of satellite communications. Five generations of this kind of satellite have been developed (Figure 4-3). From then on, countries such as Soviet Union, France, Great Britain, Federal Germany, Japan, Canada, Indonesia and China, etc. have successively joined the rank of satellite communications which further promoted the development of satellite communications technologies.

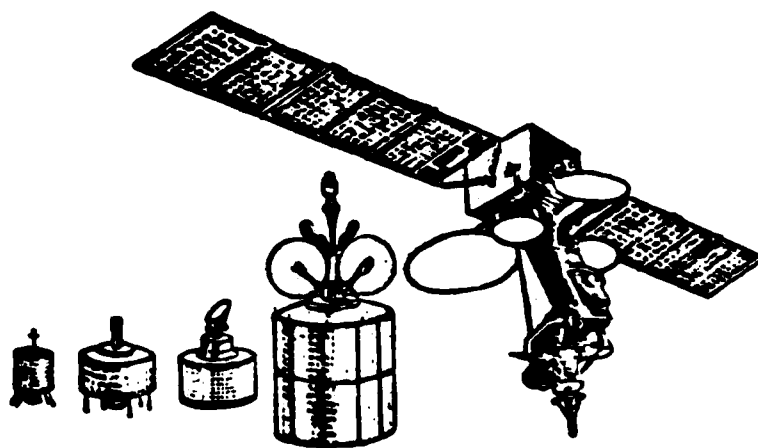


Fig. 4-3 From left to right are "International Communications Satellite"-1 -- 5.

On April 8, 1984, China used the "Long March"-3 three-stage liquid rocket (Fig. 4-4) to launch her first geostationary orbital communications satellite, making her the world fifth country which has independently launched a geostationary orbital satellite. Said satellite was named the "East is Red"-2 (Fig. 4-4) and weighed 461 kilograms with 2.1 meters in diameter, 3.1 meters in height and 0.7 degree in orbital inclination angle.

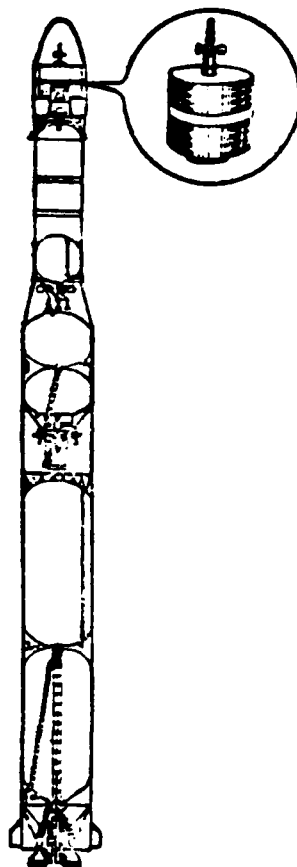


Fig. 4-4

Presently, a dozen kind of various military and civilian communications satellites have been developed and close to a thousand of them have been launched; those with high communications capacity can reach 13,000 voice channels; satellite communications have become the primary means for international and domestic telephone, telegraph, television, facsimile and data transmission.

Reconnaissance Satellites Have Come on Top From Behind

In order to unveil the iron curtain of strategic weapon manufactured by the Soviet Union and understand the intelligence information of its activities, the United States had started the secret design and research of reconnaissance satellites as early as between 1952 and 1953 through "RAND Corporation" and under the leadership of the Central Intelligence Agency, and it was called the "Feedback Project" at that time. By March 16, 1955, the U.S. Air Force proposed the practical project of a reconnaissance satellite system codenamed "WS-117L", i.e., the Discoverer, Samos and Midas projects, and selected three companies---"Martin", "Lockheed" and "American Radio", to conduct a one-year research and design undertaking. Under the shock of the Soviet's launching of her first satellite, the United States accelerated the pace of manufacturing of reconnaissance satellites and finally on February 28, 1959 successfully launched the first test reconnaissance satellite---"Discoverer-1" (Fig. 4-5).

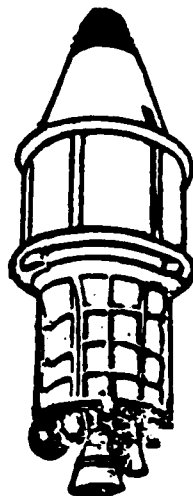


Fig. 4-5

Reconnaissance satellites include three types: photographic reconnaissance; electronic reconnaissance; and guided missile early

warning; "Discoverer"-1 belonged to the rank of photographic reconnaissance satellites.

"Discoverer"-1 was launched from Vandenberg Air Force Base (located in Cape Arguello which is 150 miles northwest of Los Angeles on the West Coast of the U.S.) using the "Zeus-Arkina" two-stage liquid payload rocket. Said satellite was the first polar orbit satellite of the U.S. (its orbit passed over the north and south poles).

"Discoverer" project was a comprehensive test project whose primary purpose was to verify and master the basic technologies of launching reconnaissance satellites, especially the retrieval technology. There has been a total of 38 such satellites launched since the first "Discoverer".

The manufacturing of radio transmission-type photographic reconnaissance satellites was being carried out while the retrieval-type photographic reconnaissance satellites were being tested, and the first transmission-type photographic reconnaissance satellite---"Samos-2" was successfully launched on January 31, 1961. It operated in its orbit for over one month and used the star panoramic scanning camera to take several hundred photographs and then, through facsimile, transmitted them to several ground stations.

According to the estimate made by U.S. intelligence branches in 1959, the Soviet Union could have deployed 120 combat intercontinental guided missiles by the summer of 1961. However, by September 1961, through analyses of retrieved and transmitted photographs by the

"Discoverer" and "Samos-2", the U.S. authority lowered the original estimated number down to 14 thereby clearing up the truth about the Soviets' "guided missile superiority" and causing the value of reconnaissance satellite to increase tremendously.

The Soviet Union, from the success of U.S. photographic reconnaissance satellites, realized the excellent effects of reconnaissance satellites and also started the manufacturing of reconnaissance satellites and began launching photographic reconnaissance satellites---"Cosmo" in 1962. Said satellite was shaped like a cylindrical body with a spherical tip and was 5 meters in height and 2.4 meters in diameter.

Starting from 1962 the photographic reconnaissance satellite had entered the period of practical applications and the number of its launchings had increased drastically to become number one among all satellites very quickly. Photographic reconnaissance satellites have been constantly upgraded and the U.S. has currently developed the fourth generation---"Big Bird" (Fig. 4-6) and the fifth generation---"Lockeye" (Fig. 4-7) whose performances have been greatly upgraded: the ground resolving power of reconnaissance photographs has been upgraded from the initial 3-7 meters to 0.3 meter at present; and it has night-vision and see-through capabilities; namely, it is capable of using an infrared camera to take pictures at night, and it can also use microwave radiometer and multi-spectrum camera to penetrate clouds, fogs and camouflages to discover targets; the working life expectancy of satellites has increased from 2-3 days in the early years to 3-5 months, and even longer. Thus, not only the number of satellites

launched can be reduced but also funding expenditures are saved.

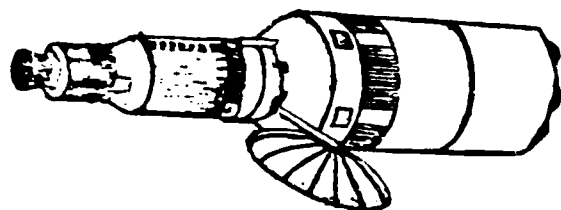


Fig. 4-6

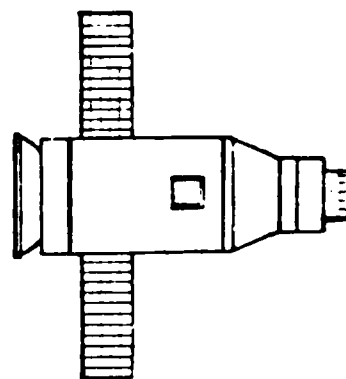


Fig. 4-7

Utilizing satellites to conduct photographic reconnaissance cannot only accurately and timely detect the quantity and position of heavy military equipment such as guided missile, aircraft, tank and ship, etc., monitor situations of airports, harbors and troop movements, and can even identify car models, aircraft types....on the ground.

Since the first successful launch of the intercontinental guided missile in August of 1957 by the Soviet Union, the U.S. thought that it has lost her guided missile superiority and that there existed a larger "guided missile gap" between itself and the Soviet Union; at that time the U.S. deeply felt the serious threat of a sudden nuclear attack by the Soviet guided missiles. For this reason, the U.S. started in 1958 the research and manufacturing of satellites for early warning of guided missiles in order to detect at any time the launch of Soviet intercontinental guided missiles, sound alarm in time and fight for more time for defense and counterattack. On May 24, 1960 the U.S. launched her first guided missile early warning satellite---"Midas-2" (Fig. 4-8). "Midas" satellite flight test had been conducted several times, but it was abandoned later because it could not meet the

requirements.

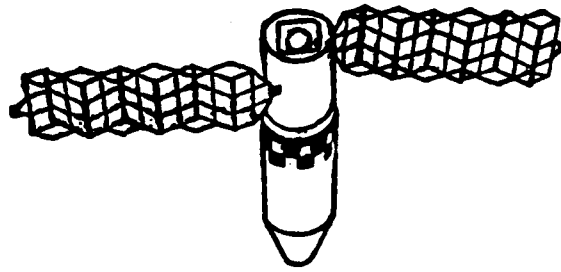


Fig. 4-8

By August 6, 1968, the U.S. was able to successfully launch a functional-type near-geosynchronous orbital early warning satellite owing to the advances in satellite launching technologies. It was modified later and launched into orbit on May 5, 1971 to formally begin operation with code number 647 (Fig. 4-9). This was a type of comprehensive guided missile early warning satellite which was equipped with an infrared telescope of 3.63 meters in length and 0.91 meter in caliber, visible light television camera and three sets of antennae for transmitting and receiving signals.

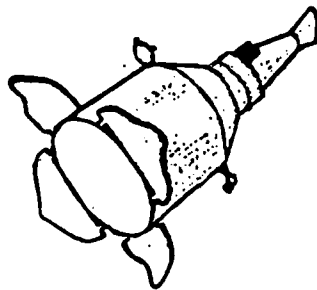


Fig. 4-9

The U.S. has deployed three 647 geosynchronous early warning satellites at stationary points over the Indian Ocean and the equator in the Western Hemisphere. It is reported that these satellites can provide a 25-minute early warning time against intercontinental ballistic guided missiles and a 15-minute early warning time against

underground guided missiles.

In the late fifties the Soviet Union started the manufacturing of an early warning satellite following the U.S. and in mid-sixties it probably conducted early stage guided missile early warning tests using the "Lightning" communications satellite. By September 19, 1972 it was able to launch for the first time a functional guided missile early warning satellite---"Cosmo-520" from Pleshitzk launch site. On October 8, 1975 the Soviet Union launched her first geosynchronous orbital early warning satellite---"Cosmo-775" from Baikenur launch site and it was set stationary over the Atlantic Ocean.

The duty of electronic reconnaissance satellites is to intercept radio waves of military transceiver and radar, eavesdrop on enemy communications messages in order to understand the performance and deployment of enemy transceiver and radar thereby know the enemy situations well, which is beneficial to combat.

The U.S. originally started off with electronic reconnaissance tests using photographic reconnaissance satellites, and not until May 25, 1962 was it able to launch the first electronic reconnaissance satellite---"Discoverer" from Vandenberg Air Force Base, which was a detail-type electronic reconnaissance satellite. Its duty was to conduct key reconnaissance on already identified targets in order to obtain more detailed intelligence. The American general-type electronic reconnaissance satellite was known as P-11 with relatively small sizes and light weight. It resembled a column with 8 sides and was always launched along with a general photographic reconnaissance

satellite. Currently, the number of U.S. electronic reconnaissance satellites have decreased sharply and it looks as if the photographic reconnaissance satellites would carry out the duty on their behalf.

The Soviet Union's electronic reconnaissance satellites and photographic reconnaissance satellites were developed at the same time. Since the launch of the first Soviet electronic reconnaissance satellite---"Cosmo-148" on March 18, 1967, there have been numerous electronic reconnaissance satellites entering orbits to operate and they top all military satellites in number launched by the Soviet Union.

Meteorological Satellites Watch Over the Globe

The U.S. was the first country in the world to have launched a meteorological satellite. On April 1, 1960 it used the "Zeus-Abur" payload rocket to launch the world first meteorological satellite---"Thylus"-1 (Fig. 4-10) from the Kennedy Space Center at Cape Canaveral. This satellite was an experimental one in column-shape with 18 faces and was 48.26 centimeters in height and 106.68 centimeters in diameter. Major equipment on the satellite were television camera, remote-control magnetic tape recorder and photographic data transmission device. It took a total of 22,952 cloud charts and geographical photographs after circling around the earth 1,135 times, and the useful rate of those pictures reached 60%.

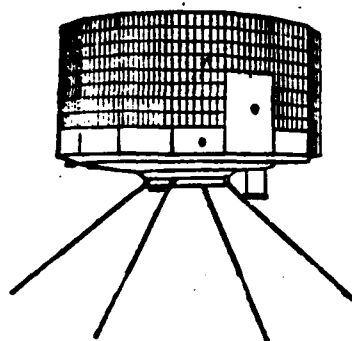


Fig. 4-10

Through experimental improvements using the "Thylus" series satellite, the U.S. launched the first functional meteorological satellite ---"Issac"-1, on February 3, 1966. Said satellite's shape, size were similar to those of the "Thylus" satellite and it operated in near-polar and solar-synchronous orbits. After "Aisa"-2, several "Issac", "Noah" and "Rainclouds" series meteorological satellites were launched, and the majority of them adopted the near-circle polar solar-synchronous orbits. Since the types of on-board instruments have increased and their performance upgraded, the items of meteorological observations have become more complete and their quality perfected by the day.

Since 1963, the Soviet Union started to launch "Cosmo" series meteorological satellites and they primarily served as military reconnaissance satellites. Through many years of launching and improvement, the first "Meteorite" series functional meteorological satellite (Figure 4-11) was launched on March 20, 1969.

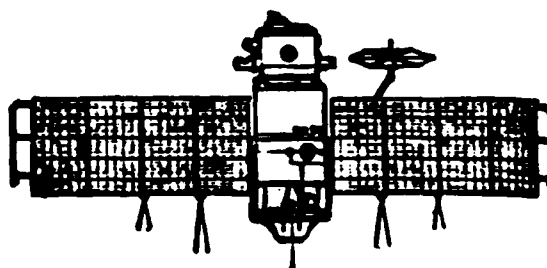


Fig. 4-11

The U.S. launched its first synchronous meteorological satellite ---"Synchronous Meteorological Satellite"-1, on May 17, 1974. Major equipment carried on-board said satellite included visible light and infrared light self-rotating scanning radiometer and data collection-transmission system which could continuously monitor weather changes within the vision of the satellite day and night around the clock to provide two-dimensional cloud charts with resolving power of 0.9 meter; determine wind speed and direction; and measure ambient temperature and humidity distribution charts from the surface of the earth to an altitude of 50,000 feet.

Following the U.S. and the Soviet Union, France, Japan and the European Space Agency (consisting of a dozen European countries), etc. have successively launched meteorological satellites.

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